WHAT IS CLAIMED IS:

1. An apparatus for controlling an optical wavelength of a control target light outputted from a variable wavelength light source, comprising:

a wavelength scanning unit for scanning at a prescribed period the control target light entered from the variable wavelength light source and obtaining optical pulses having a phase corresponding to the optical wavelength of the control target light; and

a phase detection unit for detecting a phase difference between a phase of the optical pulses and a phase corresponding to a reference optical wavelength, and controlling the variable wavelength light source by feeding back the phase difference to the variable wavelength light source such that the optical wavelength of the control target light is controlled by an optical frequency pulling with respect to the reference optical wavelength according to the phase difference.

2. The apparatus of claim 1, further comprising:

a reference signal generation unit for generating a reference signal having a phase corresponding to the reference optical wavelength in synchronization with a scanning period of the wavelength scanning unit, such that the phase detection unit detects the phase difference between two inputs of the optical pulses outputted from the wavelength scanning unit and the reference signal outputted from the reference signal generation unit by directly comparing phases of the two inputs.

3. The apparatus of claim 2, wherein the phase detection unit includes a filter for discriminating a fundamental frequency component of the optical pulses and obtains the phase difference from an output signal of the filter and

the reference signal.

4. The apparatus of claim 1, wherein the wavelength scanning unit also receives an externally entered reference light having the reference optical wavelength and obtains reference optical pulses having a phase corresponding to the reference optical wavelength, such that the phase detection unit detects the phase difference between two inputs of the optical pulses and the reference optical pulses outputted from the wavelength scanning unit by directly comparing phases of the two inputs.

5. The apparatus of claim 4, wherein the phase detection unit includes a first filter for discriminating a fundamental frequency component of the optical pulses and a second filter for discriminating a fundamental frequency component of the reference optical pulses, and obtains the phase difference from output signals of the first filter and the second filter.

6. The apparatus of claim 4, wherein the phase detection unit includes a phase shift circuit for setting an offset to the phase of the reference optical pulses.

7. The apparatus of claim 4, further comprising:

an optical phase locked loop circuit into which the control target light and the reference light as entered into the wavelength scanning unit are also entered.

8. The apparatus of claim 1, wherein the wavelength scanning unit obtains the optical pulses by using a disk shaped tunable optical filter in which a transmission wavelength is varied linearly and periodically with respect to time as the disk shaped tunable optical filter is rotated.

9. The apparatus of claim 8, wherein the wavelength scanning unit also obtains a reference signal having a phase corresponding to the reference optical wavelength by reading off a marker provided on the disk shaped tunable optical filter, such that the phase detection unit detects the phase difference between the optical pulses and the reference signal.

10. The apparatus of claim 9, further comprising a phase shift circuit for setting an offset to the phase of the reference signal outputted from the wavelength scanning unit.

11. The apparatus of claim 10, further comprising a phase shift control circuit for controlling an amount of phase shift to be set to the phase shift circuit, according to a calibration information by which the wavelength scanning unit is calibrated.

12. The apparatus of claim 1, wherein the wavelength scanning unit obtains the optical pulses by using an acousto-optic tunable filter driven by an RF signal source, in which a transmission optical wavelength is varied linearly and periodically with respect to time.

13. An apparatus for controlling an optical wavelength of a control target light outputted from a variable wavelength light source, comprising:

an optical diffraction unit for diffracting the control target light entered from the variable wavelength light source into a direction corresponding to the optical wavelength of the control target light;

a periodic signal generation unit for detecting a diffraction light diffracted by the optical diffraction

unit and generating periodic signals with a phase varied according to a diffraction direction of the diffraction light; and

a phase detection unit for detecting a phase difference between a phase of the periodic signals and a phase corresponding to a reference optical wavelength, and controlling the variable wavelength light source by feeding back the phase difference to the variable wavelength light source such that the optical wavelength of the control target light is controlled by an optical frequency pulling with respect to the reference optical wavelength according to the phase difference.

14. The apparatus of claim 13, wherein the periodic signal generation unit generates the periodic signals by using a photo-detector array in which the phase of the periodic signals is varied depending on a photo-detector cell of the photo-detector array which detected the diffraction light.

15. An apparatus for controlling optical wavelengths of control target lights outputted from N variable wavelength light sources, where N is an integer, the apparatus comprising:

a periodic modulation signal generation unit for generating N periodic modulation signals in mutually different frequencies, according to which the control target lights are to be modulated;

a wavelength scanning unit for scanning at a prescribed period the control target lights modulated at the mutually different frequencies and obtaining N optical pulses having phases respectively corresponding to the optical wavelengths of the control target lights;

a control signal generation unit for generating N control signals respectively from the N periodic modulation signals and N reference signals having phases respectively

corresponding to reference optical wavelengths for the N variable wavelength light sources; and

a phase detection unit for detecting N phase differences between phases of respective ones of the N optical pulses and phases of respective ones of the N control signals, and controlling the N variable wavelength light sources by feeding back the N phase differences to the N variable wavelength light sources respectively such that the optical wavelengths of the control target lights are controlled by an optical frequency pulling with respect to the reference optical wavelengths according to the N phase differences respectively.

16. The apparatus of claim 15, wherein the control signal generation unit generates the N control signals by multiplying respective ones of the N periodic signals with respective ones of the N reference signals.

17. The apparatus of claim 15, wherein the wavelength scanning unit obtains the optical pulses by using a disk shaped tunable optical filter in which a transmission wavelength is varied linearly and periodically with respect to time as the disk shaped tunable optical filter is rotated, or an acousto-optic tunable filter driven by an RF signal source in which a transmission optical wavelength is varied linearly and periodically with respect to time.

18. An apparatus for controlling optical wavelengths of control target lights outputted from N variable wavelength light sources, where N is an integer, the apparatus comprising:

a periodic modulation signal generation unit for generating N periodic modulation signals in mutually different frequencies, according to which the control target lights are to be modulated;

an optical diffraction unit for diffracting the control target lights modulated at the mutually different frequencies into directions respectively corresponding to the optical wavelengths of the control target lights;

a periodic signal generation unit for detecting diffraction lights diffracted by the optical diffraction unit and collectively generating N periodic signals with phases varied according to diffraction directions of the diffraction lights;

a control signal generation unit for generating N control signals respectively from the N periodic modulation signals and N reference signals having phases respectively corresponding to reference optical wavelengths for the N variable wavelength light sources; and

a phase detection unit for detecting N phase differences between phases of respective ones of the N periodic signals and phases of respective ones of the N control signals, and controlling the N variable wavelength light sources by feeding back the N phase differences to the N variable wavelength light sources respectively such that the optical wavelengths of the control target lights are controlled by an optical frequency pulling with respect to the reference optical wavelengths according to the N phase differences respectively.

19. The apparatus of claim 18, wherein the control signal generation unit generates the N control signals by multiplying respective ones of the N periodic signals with respective ones of the N reference signals.

20. The apparatus of claim 18, wherein the periodic signal generation unit generates the N periodic signals by using a photo-detector array in which the phases of the N periodic signals are varied depending on photo-detector cells of the photo-detector array which detected the diffraction lights.

21. A method for controlling an optical wavelength of a control target light outputted from a variable wavelength light source, comprising the steps of:

scanning at a prescribed period the control target light entered from the variable wavelength light source and obtaining optical pulses having a phase corresponding to the optical wavelength of the control target light;

detecting a phase difference between a phase of the optical pulses and a phase corresponding to a reference optical wavelength; and

controlling the variable wavelength light source by feeding back the phase difference to the variable wavelength light source such that the optical wavelength of the control target light is controlled by an optical frequency pulling with respect to the reference optical wavelength according to the phase difference.

22. A method for controlling an optical wavelength of a control target light outputted from a variable wavelength light source, comprising the steps of:

diffracting at an optical diffraction device the control target light entered from the variable wavelength light source into a direction corresponding to the optical wavelength of the control target light;

detecting a diffraction light diffracted by the optical diffraction device and generating periodic signals with a phase varied according to a diffraction direction of the diffraction light;

detecting a phase difference between a phase of the periodic signals and a phase corresponding to a reference optical wavelength; and

controlling the variable wavelength light source by feeding back the phase difference to the variable wavelength light source such that the optical wavelength of

the control target light is controlled by an optical frequency pulling with respect to the reference optical wavelength according to the phase difference.

23. A method for controlling optical wavelengths of control target lights outputted from N variable wavelength light sources, where N is an integer, the method comprising the steps of:

generating N periodic modulation signals in mutually different frequencies, according to which the control target lights are to be modulated;

scanning at a prescribed period the control target lights modulated at the mutually different frequencies and obtaining N optical pulses having phases respectively corresponding to the optical wavelengths of the control target lights;

generating N control signals respectively from the N periodic modulation signals and N reference signals having phases respectively corresponding to reference optical wavelengths for the N variable wavelength light sources;

detecting N phase differences between phases of respective ones of the N optical pulses and phases of respective ones of the N control signals; and

controlling the N variable wavelength light sources by feeding back the N phase differences to the N variable wavelength light sources respectively such that the optical wavelengths of the control target lights are controlled by an optical frequency pulling with respect to the reference optical wavelengths according to the N phase differences respectively.

24. A method for controlling optical wavelengths of control target lights outputted from N variable wavelength light sources, where N is an integer, the method comprising the steps of:

generating N periodic modulation signals in mutually different frequencies, according to which the control target lights are to be modulated;

diffracting the control target lights modulated at the mutually different frequencies into directions respectively corresponding to the optical wavelengths of the control target lights;

detecting diffraction lights diffracted by the optical diffraction unit and collectively generating N periodic signals with phases varied according to diffraction directions of the diffraction lights;

generating N control signals respectively from the N periodic modulation signals and N reference signals having phases respectively corresponding to reference optical wavelengths for the N variable wavelength light sources; and

detecting N phase differences between phases of respective ones of the N periodic signals and phases of respective ones of the N control signals, and controlling the N variable wavelength light sources by feeding back the N phase differences to the N variable wavelength light sources respectively such that the optical wavelengths of the control target lights are controlled by an optical frequency pulling with respect to the reference optical wavelengths according to the N phase differences respectively.